BOOK OF ABSTRACTS

I. SESSION DESCRIPTION

ID: T9a

Exploring the connections between biodiversity and human health

Hosts:

	Name	Organisation	E-mail
Host:	Joana Costa Robbert Boudewijns	University of Coimbra KU Leuven	jcosta@uc.pt robbert.boudewijns@kuleuven.be
Co-host(s):	Isabel Henriques Ellen Decaestecker Ben Somers Stien Heremans	University of Coimbra KU Leuven KU Leuven KU Leuven	isabel.henriques@uc.pt ellen.decaestecker@kuleuven.be ben.somers@kuleuven.be stien.heremans@kuleuven.be

Abstract:

Several ecosystem services can be linked to beneficial health effects in humans, such as the purification of water or the provision of food, mitigation of air pollution, climate regulation, and beneficial mental health effects [1,2].

In turn, the ability of ecosystems to provide ecosystem services is in large part defined by their composition, i.e. the biodiversity contained within them [3], on any scale: from a diversity in animals and vegetation, to diversity in soil and plant microbiota. Although various links between biodiversity and health have already been shown, there is still much to understand about the mechanisms behind the mutual benefits between biodiversity, ecosystem services and human health [2].

Biodiversity may also impact disease transmission, yet conflicting hypotheses suggest that a reduction in biodiversity can mean either a higher or lower transmission. After all, high biodiversity can dilute pathogens among multiple host species, reducing disease risk (the so-called 'dilution effect') [1], or promote transmission by providing a larger pool of vectors and

organisms that could be the source of novel pathogens [4]. Further research is needed to elucidate the effects of biodiversity on disease transmission, and to which extent pathogen, host and/or environmental factors play a role in which effect is predominant.

In addition, our modern lifestyle has impacts on our exposure to biodiversity. Urbanized populations, who increasingly less often come in contact with natural antigens such as in pollen or food have a higher prevalence of allergy [5]. Also a loss in food diversity in modern-day diets has been linked to a rise in non-communicable diseases [6] and less diverse gut microbiota, although the relative impact of genetics, environmental and lifestyle factors on this diversity remains only partially understood [7].

In conclusion, despite indications that biodiversity, from microbiota to plants and animals, has a beneficial effect on health, conflicting evidence exists to suggest that a high biodiversity is not exclusively linked to positive health effects alone. Moreover, the evidence linking biodiversity with direct and long-term health outcomes is scarce, which calls for additional research.

References

[1] Aerts, Raf, Olivier Honnay, and An Van Nieuwenhuyse. "Biodiversity and human health: mechanisms and evidence of the positive health effects of diversity in nature and green spaces." British medical bulletin 127.1 (2018): 5-22.

[2] Zhang, Yixin, et al. "Biodiversity, ecosystem functions and services: Interrelationship with environmental and human health." Frontiers in Ecology and Evolution 10 (2022): 1086408.

[3] Mace, Georgina M., Ken Norris, and Alastair H. Fitter. "Biodiversity and ecosystem services: a multilayered relationship." Trends in ecology & evolution 27.1 (2012): 19-26.

[4] van Langevelde, Frank, et al. The link between biodiversity loss and the increasing spread of zoonotic diseases. European Parliament, 2020.

[5] Haahtela, Tari. "A biodiversity hypothesis." Allergy 74.8 (2019): 1445-1456.

[6] Sarkar, Dipayan, Jacob Walker-Swaney, and Kalidas Shetty. "Food diversity and indigenous food systems to combat diet-linked chronic diseases." Current developments in nutrition 4 (2020): 3-11.

[7] Flandroy, Lucette, et al. "The impact of human activities and lifestyles on the interlinked microbiota and health of humans and of ecosystems." Science of the total environment 627 (2018): 1018-1038.

Goals and objectives of the session:

The aim of this session is to showcase recent advancements in our understanding of the direct and indirect relationships that exist between genetic, species and/or ecosystem diversity on the

one hand, and human health effects, including physical and mental wellbeing, communicable and non-communicable diseases on the other.

Planned output / Deliverables:

Through the presentations and panel discussion we aim to identify gaps in our understanding of the relationship between biodiversity and human health, and to develop collaboration opportunities moving forward.

II. SESSION PROGRAM

Room: Expert Street 7

Date of session: 19th of November 2024

Time of session: 16:00-18:00

Timetable speakers

Time	First name	Surname	Organization	Title of presentation
16:00-16:12	Karine Lalaina	Mahefarisoa	KU Leuven	Environmental, animal and human health: a "One Health" approach to protected area management and governance in Madagascar
16:12-16:24	Isabel	Henriques	University of Coimbra	The Influence of Microplastics on Pathogens and Antibiotic Resistance Spread in Rivers: A Portuguese River Case Study
16:24-16:36	Maria	Korneykova	Peoples' Friendship University of Russia	Opportunistic fungi in urban arctic ecosystems (on the example of largest polar city Murmansk)
16:36-16:48	Rupert	Legg	Leibniz University Hannover	The effects of urbanisation and climate change on the allergenicity of pollen within urban green spaces: A systematic review
16:48-17:00	Sarah	Smet	University of Namur	Use of scenarios to evaluate the impacts of nitrogen deposition on pollen allergy prevalence in Belgium through the lens of biodiversity losses.
17:00-17:12	Jana	Verboom	Wageningen University	Pathways between nature and health; the role of awareness of nature

Time	First name	Surname	Organization	Title of presentation
17:12-17:24	Marcelle	Lock	RIVM (Dutch National Institute for Public Health and the Environment)	Benefits for human health through nature exposure in urban green space
17:24-18:00	All presenters	All presenters		Discussion session

III.ABSTRACTS

The first author is the presenting author unless indicated otherwise.

1. Opportunistic fungi in urban arctic ecosystems (on the example of largest polar city Murmansk, Russia)

First authors(s): Maria Korneykova
Other author(s): Anastasia Soshina
Affiliation: RUDN University
Contact: korneykova.maria@gmail.com

The relevance of studying Arctic regions is growing rapidly due to the sensitive response of fragile ecosystems under climate change and increasing anthropogenic pressures. Under the urbanization impact, there is a significant transformation of abiotic and biotic properties of ecosystems, which affects the ecosystem services provided and can lead to disservices such as the emergence and accumulation of microbial species hazardous to health, including microfungi. Pathogenic and opportunistic fungal species are becoming increasingly important with the growing recognition of chronic diseases and the number of patients with severe immunodeficiencies. However, studies of opportunistic microfungi in Arctic cities are sporadic. In this case, the opportunistic microfungi of Murmansk, the largest Arctic city in the world, was studied in comparison with a background area of natural forest tundra. Mycological analysis was carried out for different components of urban ecosystems: soil cover, atmospheric air, water and lake bottom sediments.

In urban soil and bottom sediments of urban lakes there was an increase in the diversity and number of opportunistic species of microfungi from 30% in background soil/lake to 50-60% in

urban soil and 50–100% in bottom sediments of urban lakes. In the air and water, the content of species harmful to human health did not differ from the background level. This emphasizes the high indicative value of buffer components of ecosystems – soil and bottom sediments, as compared to transit components – air and water, in determining the level of long-term anthropogenic load on ecosystems. The most dangerous identified species were fungi Paecilomyces variotii, Aspergillus flavus and Aspergillus fumigatus, capable of causing pulmonary infections, otitis, sinusitis, endocarditis, osteomyelitis, keratitis, traumatic mycoses, peritonitis, onychomycosis. The fact of Paecilomyces variotii dominance in water and bottom sediments of lakes used for recreational purposes is alarming.

Keywords: disservices, soil, air, lake water, lake sediments

2. The effects of urbanisation and climate change on the allergenicity of pollen within urban green spaces: A systematic review

First authors(s): Rupert Legg
Other author(s): Nadja Kabisch
Affiliation: Leibniz University Hannover
Contact: legg@phygeo.uni-hannover.de

Current global environmental challenges, such as urbanisation and climate change, are shifting nature in ways that will have numerous consequences for human health. For instance, growing research over the past two decades has determined that the allergenic potential of pollen emitted within urban green spaces is increasing. A number of factors relating to urbanisation and climate change have been observed to contribute to this increasing allergenicity, including rising temperatures, air pollution, low biodiversity, abundance of allergenic species, introduction of non-native and invasive species, planning preferences for male plants in dioecious species, poor management and maintenance of green spaces, and cross-reactivity between related species. An updated collation and holistic evaluation of this evidence is required as previous reviews have been non-systematic and are over a decade old. Research conducted in the past decade, particularly given the increasing severity of climate change impacts felt across this time, should be reconsidered in an updated exploration of how allergenicity is increasing. Supporting this need, recent research has revealed a number of possible additional factors that might affect the allergenicity of pollen within green spaces, such as thunderstorms, drought, soil contamination and soil health, and even possibly night-time light pollution. The extent to which evidence agrees that these factors also influence the allergenicity of pollen remains unexamined, so a new systematic review holistically considering

all of this evidence is required. Consequently, in this paper, we systematically review the research exploring how the allergenicity of pollen in urban green spaces is affected by processes relating to urbanisation and climate change. In doing so, we construct a conceptual framework depicting all of the established ways in which the allergenicity of pollen is being influenced by global environmental change. We also highlight how green space planners can minimise the allergenicity of pollen, reducing the burden of allergenic disease.

Keywords: Allergenicity; pollen; green space; climate change; urbanisation

3. Use of scenarios to evaluate the impacts of nitrogen deposition on pollen allergy prevalence in Belgium through the lens of biodiversity losses

First authors(s): Sarah Smet
Affiliation: University of Namur, Namur, Belgium
Contact: sarah.smet@unamur.be

The combustion of fossil fuels and the intensive application of artificial fertilizers in agriculture result in the atmospheric deposition of nutrients, particularly nitrogen. This phenomenon poses a growing threat to both the environment and human health. In Belgium, the exposure of ecosystems to excessive nitrogen loads significantly increases from southeast to northwest. The ecological repercussions of nitrogen enrichment include biodiversity loss, alterations in plant distributions, ecosystem simplification, and a decline in ecosystem service provisioning capacity (Tilman et al. 2001; Wang et al. 2018). Excessive nitrogen typically leads to more productive ecosystems dominated by a few highly competitive plant species, resulting in species-poor environments (Bobbink et al. 2010; Damgaard et al. 2011). It is hypothesized that changes in nitrogen concentration, plant community composition, and productivity may influence airborne pollen distributions, abundances, and allergen potency. This environmental nitrogen deposition can have direct and indirect impacts on aeroallergens, affecting the prevalence and severity of allergic diseases. The NITROPOL project aims to quantify the respiratory allergic disease burden attributable to nitrogen pollution through modification of the ecosystem diversity. Land use change scenarios and scenario-specific biodiversity changes in Belgian nature are simulated to assess potential impacts on pollen abundance and allergenicity with additional scenario specific changes being implemented in order to simulate the impact of policy actions at the urban and rural levels. At the urban levels, we propose parameters that control the density and biodiversity levels of greenspaces as well as their biodiversity levels, regulated through the mowing frequency. In rural areas, the diversity of grasslands can be controlled by regulation from the agricultural sectors, and the density of urbanization by the land use planning.

Additionally, the impacts of climate and N deposition is assessed on the abundance of birches on forested and non-forested areas and on the grasslands diversity composition.

Keywords: nitrogen deposition, pollen, allergen potency, grasslands, birch

4. Pathways between nature and health; the role of awareness of nature

First authors(s): Jana Verboom
Other author(s): Esmee van den Berg
Affiliation: Wageningen University & Research
Contact: jana.verboom@wur.nl

There is a large and growing body of evidence for the fact that nature and/or biodiversity is good for our mental and physical health and wellbeing. However, there is no consensus about the pathway between nature (biodiversity) and health. In a recent paper, four domains of pathways—both beneficial as well as harmful—were suggested to link biodiversity, or nature, with human health: (i) reducing harm (e.g. decreasing exposure to air and noise pollution); (ii) restoring capacities (e.g. attention restoration, stress reduction); (iii) building capacities (e.g. promoting physical activity, transcendent experiences); and (iv) causing harm (e.g. dangerous wildlife, zoonotic diseases, allergens). In some papers, a link with gut biome was made: having a biodiverse gut biome, from contact with a biodiverse environment, was postulated as part of an alternative pathway. Another recent study points at nature awareness ("noticing nature") as an important intermediate concept between the mere presence of nature, or nature exposure, and health benefits. In this paper we will discuss the evidence base for this latter alternative pathway. We will present the results of Wageningen master students who wrote their thesis about aspects of nature experience/nature awareness and health and/or wellbeing metrics. One of these studies found no significant extra effect of noticing nature – as an addition to the significant positive effect of spending time in nature – in a study with over 1000 participants. Is it then possible to get the positive effects of nature unconsciously? Without even noticing nature? Suggestions for future research will be given.

Keywords: nature, health, wellbeing, awareness

5. Benefits for human health through nature exposure in urban green space

First authors(s): Marcelle Lock
Other author(s): Niels Schoffelen, Loes Geelen, Maciek Strak, Arjen Gootzen
Affiliation: RIVM (National Institute for Public Health and the Environment)
Contact: marcelle.lock@rivm.nl

This study investigates the effects of urban green space (UGS) on physical and mental health. It aims to provide an overview of which relationships can be quantified, as well as to investigate the mechanisms, complicating factors and difficulties regarding the relationship between UGS and human health.

We conducted a literature review to attain an overview of the most recent and robust findings from metareview studies on quantifiable relationships between UGS and various health outcomes. This input has been used to create an overview on quantifiable relationships between UGS and human health. Most review studies have investigated the relationship between UGS and different types of health problems, such as diabetes, heart failure, Alzheimer's, birth outcomes, and mental disorders such as depression. It is quite difficult to quantify how the prevalence of a certain disease correlates with gradients in the presence of urban green space. The mechanisms are often unclear and can be intertwined with effects of climate change, such as heat stress. Health effects due to the presence of UGS can be quantified, but it is impossible to pin it down to a specific health outcome. Also, most studies use their own definition of UGS, making it challenging to establish universal green space definition improving scientific comparability. One of the found relationships has been used to build a predictive model that calculates the general health outcome ‘mortality’ for urban areas, which is now part of the Groene Baten Planner (Green Benefit Planner, RIVM).

An integrated and intersectoral approach to UGS research including more detailed and standardized approaches to analyze UGS’s could greatly improve scientific insights on the relevance of climate, health and city planning. We propose a couple of approaches how this can be done.

Keywords: green cities, health impact, mental health, physical health, urban green space

6. Environmental, animal and human health: a “One Health” approach to protected area management and governance in Madagascar

First author(s): Karine Lalaina Mahefarisoa

Other author(s): Raf Aerts, Karen Bisschop, Emmanuel André, Irwin Mitchell, Piet Maes, Jelle Matthijnssens, Fidisoa Rasambainarivo, Hajanirina Rakotondrainibe, Broos Van de Moortel, Isabel Vanoverberghe, Ellen Decaestecker

Affiliation: KU Leuven, Belgium

Contact: karine.mahefarisoa@kuleuven.be

Our research is based on the "One Health concept," which emphasizes collaboration and integration across various sectors, including human, animal, and environmental health. Due to anthropogenic disturbances, wildlife habitats are gradually shrinking, leading to increased interactions between wildlife and humans and their domestic animals. Therefore, our research focuses on identifying potential zoonotic pathogens (viruses, bacteria, and protozoa) in endemic lemur species in Madagascar. We compared the microbiome of lemur populations in disturbed and intact environments.

Fecal and blood samples were collected from lemurs in both disturbed and intact environments in four different protected areas. Metagenomic analysis, including shotgun sequencing to detect specific pathogens, and 16S amplicon sequencing, were performed to characterize microbial communities.

Our results showed differences in the microbiome composition between lemurs living in disturbed and undisturbed environments. Lemurs from disturbed environments had higher microbial diversity compared to those from undisturbed environments. We tested if certain microbial groups (opportunistic pathogens) associated with environmental degradation were more abundant in the microbiomes of lemurs from disturbed environments.

These initial findings suggest that anthropogenic pressures have a significant impact on the microbiome composition of lemurs, which could potentially affect the health of the hosts. Furthermore, the detection of (re)emerging infectious diseases could pose a threat to public health. Understanding how microbes respond to environmental disturbances is crucial for conservation efforts aimed at preserving biodiversity. Finally, early detection of potential (re)emerging infectious diseases will help prevent future pandemics.

Keywords: microbiome, anthropogenic disturbances, zoonoses, lemurs, Madagascar

7. The Influence of Microplastics on Pathogens and Antibiotic Resistance Spread in Rivers: A Portuguese River Case Study

First authors(s): Isabel Henriques
Other author(s): Inês Alçada, Flávia Ribeiro, Isable Silva, Marta Tacão
Affiliation: CFE-UC: Department of Life Sciences, Centre for Functional Ecology (CFE), Associate Laboratory TERRA, Faculty of Sciences and Technology, University of Coimbra
Contact: isabel.henriques@uc.pt

Microplastics (MPs) have been reported as ideal niches for the establishment of microbial biofilms, known as the plastisphere. We measured MPs contamination in a Portuguese river (Rio Antuã) and assessed the role of these particles in the selection and spread of pathogens and antibiotic-resistant bacteria.

Samples were collected at four locations in the river and MPs were selected and quantified. Microbial DNA was purified from the MPs and surrounding water and the microbiome was analysed by 16S rDNA targeted metagenomics. An average of 78 MPs.m-3 were collected from the river. The main microplastic polymers detected were polypropylene (PP), polyvinyl chloride (PVC), polyester and high-density polyethylene (HDPE). The diversity and richness of microbial communities in water were higher compared to those on MPs. Differences among communities were observed at the phylum, family and amplicon sequence variants (ASVs) levels. Although many putative pathogens were enriched in water, some were more abundant on MPs, such as Bacillus, Pseudomonas, Bifidobacterium and Burkholderia.

The relative contribution of different polymers to pathogens and antibiotic-resistant bacteria spread was assessed by exposing polypropylene (PP) and polyethylene (PE) MPs at the same locations, for 21 days. After exposure, potential pathogens, namely Acinetobacter, Flavobacterium and Mycobacterium, were detected in MPs. Genes of the resistome and mobilome were quantified using a SmartChip Real-Time PCR. A higher diversity of genes was detected in water compared to MPs. However, a significant enrichment of genes conferring resistance to critical antibiotics, such as blaCTX-M and blaVIM, was observed in MPs relative to water.

This study confirms the presence of high concentrations of MPs in a Portuguese river. Antibiotic resistance genes and putative pathogenic bacteria were found on microplastics, likely being transported by these particles along the river and into other ecosystems. The type of polymer influences the plastisphere composition and resistome.

Keywords: Microplastics, rivers, antibiotic resistance, pathogens, one health